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"PUFF" CONES ON MOUNT USU

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Two days before the eruption of Mount Usu, in southwestern Hokkaido, Japan, the writer arrived at the foot of the volcano. He remained there for twelve days, watching every phenomenon, going without sleep the first five days. The first explosion occurred

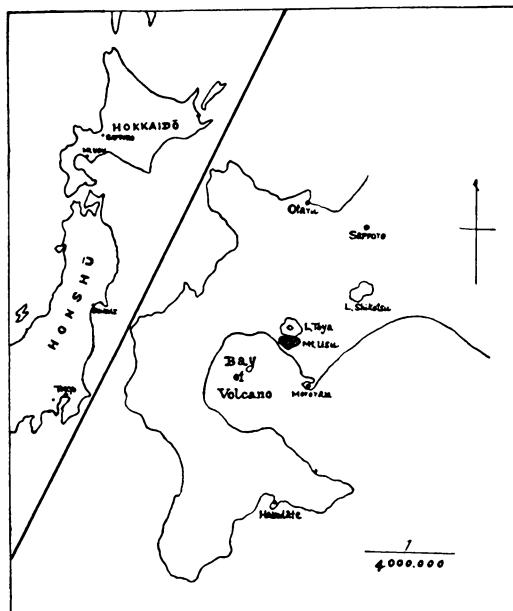


FIG. 1.—Sketch map of southwestern part of Hokkaido

on July 25, 1910, and others followed in rapid succession. Violent eruptions ceased in about ten days and the writer returned to Sapporo on August 7. He again visited the volcano in September and in December of the same year, in May and October, 1911, in

May, 1912, and in May, 1913. Many interesting facts were observed which will be published later in another paper. Here attention is to be called only to certain peculiar cones formed on one of the mud flows.

The main eruption of the volcano caused the formation of forty-five small explosion craters on its northern slope. These craters extend from east to west in two zones along Lake Toya,¹ north of the volcano. During the first few months after their formation innumerable bombs and considerable quantities of sand and ashes were blown from every craterlet. From five of them mud flowed at different times, the flow from a small crater at the southern foot of the parasite cone Nishi-Maruyam being especially interesting. This crater is located on a gentle slope of about five degrees, and is 100 meters in diameter. For twenty days it intermittently threw out columns of hot water, occasionally mingled with mud, to a height of about 60 meters. Approximately two hundred eruptions occurred per day at intervals of from three to thirty minutes. A mass of mud, estimated by the writer at 230,000 cubic meters, spread out in a sheet averaging 1.5 meters in thickness, over an area 200 by 700 meters. It covered a farm, where it destroyed a thousand apple trees and other crops, and pushed three houses in the direction of the lake and finally destroyed them.

The mud consists mainly of plagioclase, hypersthene, augite, magnetite, and hematite, and resembles the material of the sea sand at the west foot of Mount Usu. It differs, however, in also containing fragments, from the size of peas to that of nuts, of compact gray to coarse black andesite. These fragments are not usually exposed at the surface of the mud, having sunk on account of their greater size.

The materials thrown out by the crater were highly heated and sticky at the time of their eruption, and contained a great amount of water and gas. For several months the flow continued steaming, but as time passed and the moisture and gases became exhausted, it ceased, and the mass became harder and harder. A year after

¹ Lake Toya is a depression lake, according to T. Kato (*Report Earthquake Investigation Committee*, Vol. LXII).

the eruption the surface of the flow was so hard that it was difficult to discern footprints upon it, and specimens could be obtained only with the aid of a pointed stick or a hammer. At this time the surface was flat except for low, wavy undulations and very irregular sun cracks.

A year later the writer found the flow covered with thousands of small cones, each of which had an opening which was compara-

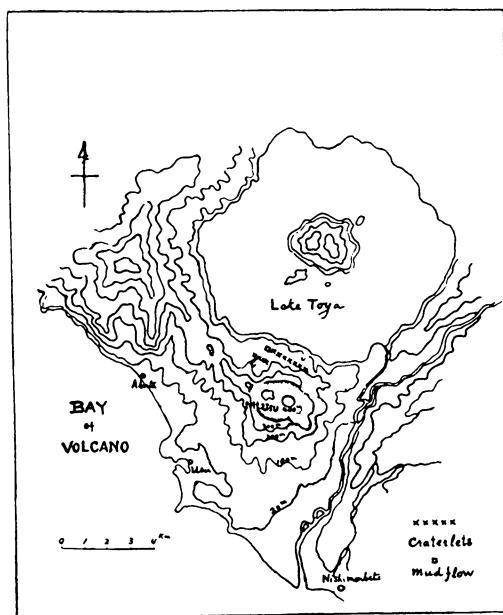


FIG. 2.—Map of Mt. Usu and vicinity, showing the position of craterlets and mud flow here described.

tively large but of no particular shape. The cones were of different sizes, the smallest being 0.5 meter in diameter and 0.1 meter in height while the largest was 3.0 meters in diameter and 1.5 meters in height. They were irregularly arranged on the flow at intervals of 10 to 30 meters, and were either dome-shaped or resembled a common bell with a slope of forty degrees.

The cause which produced these elevations is the same as that which forms small pitted cones when any viscous substance is boiled, namely, the escape of gases or vapors through the mass

and the breaking of the bubble at the surface. After the cessation of the mud flow the surface dried and sun cracks were formed. The gases near the surface rapidly escaped through these openings, but those imprisoned near the bottom of the mass were unable to do so, the upper part only having dried out. Later, by the coalescing of the small bubbles, the remaining gases united beneath the surface in reservoirs of greater size. The accumulated pressure finally became great enough to force a passage through the mud to the surface, the sudden escape of the gas forcing the mud upward



FIG. 3.—The largest “puff” cone. Photo taken by the writer, May 16, 1912

to form cones. The other mud flows in this district, being thinner, dried out more rapidly, and no cones were formed.

The writer has been unable to find descriptions of any such phenomenon in the case of other mud flows, although similar elevations occasionally occur on lava flows. He therefore suggests the name “puff cones.”

No new cones were formed after the summer of 1912, the greater part of the gas having been expelled. Since that time weathering has begun to reduce the slopes, so that, in all probability, no trace of this fantastic phenomenon will remain after a few years.